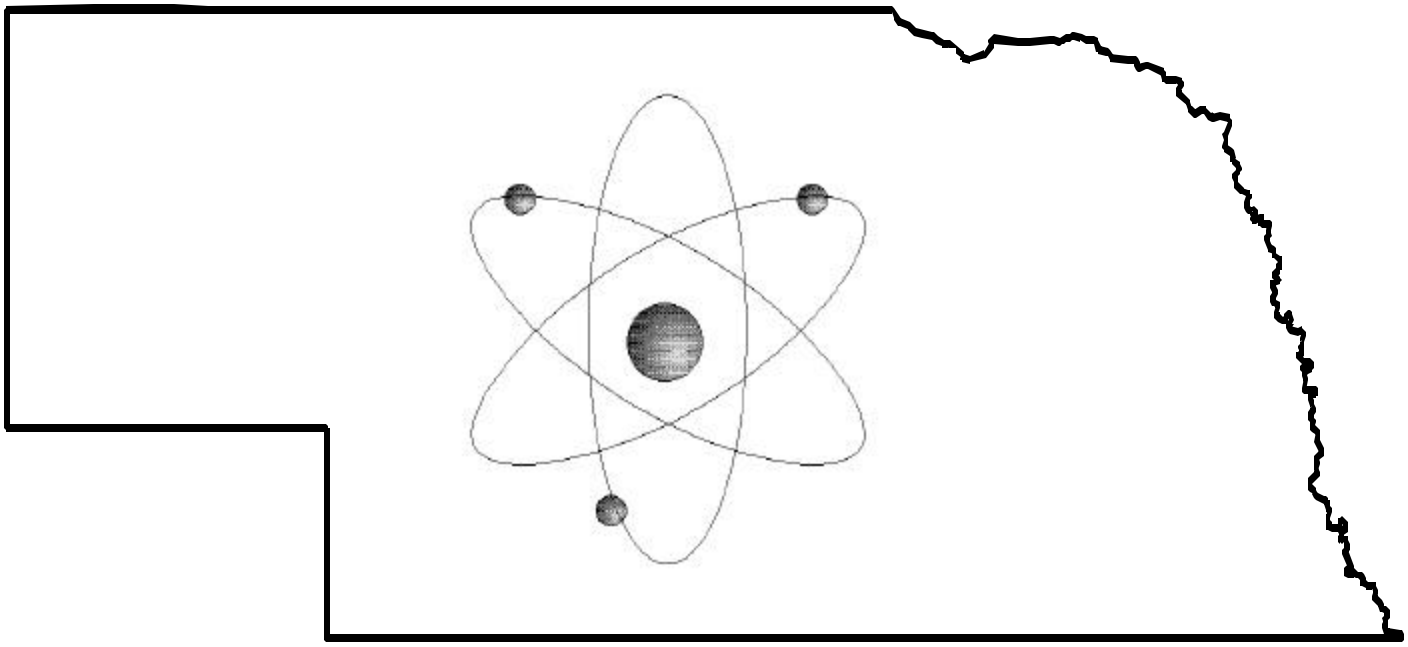
# RADON IN NEBRASKA



NEBRASKA HEALTH AND HUMAN SERVICES SYSTEM

DEPARTMENT OF REGULATION AND LICENSURE

# I. RADON FACTS

## A. Radon Defined

Radon is a radioactive gas. You can't see, smell, or taste radon. It comes from the decay of radium and exists in varying amounts in most soils. High radon concentrations can be found in soils and rocks containing uranium, granite, shale, phosphate, and pitchblende.

Because radon is a gas, it can move through soil and into a home. In outdoor air, radon is diluted to relatively harmless low concentrations. However, once trapped inside an enclosed space, radon can accumulate. Indoor radon levels depend upon the concentration of radon in the soil, the number of available paths into the building, and the strength of forces drawing radon into the building. Levels can vary greatly in the same town, on the same street, and from house to house.

## B. Health Concern

Radon is one link in a long chain of radioactive decays. Radon gas decays into metallic elements that are also radioactive. These decay products can attach to smoke, dust and other particles in air and be inhaled, remaining in the lungs to release tissue-damaging radiation.

Unlike some indoor air pollutants, radon does not cause headaches, nausea, sneezing, or other visible symptoms. Prolonged exposure to high levels of radon can lead to lung cancer – radon's only known health effect. Radon is considered to be the leading cause of lung cancer among nonsmokers. The U.S. Environmental Protection Agency (EPA) estimates that radon causes about 14,000 deaths per year in the United States.

Certain groups of people are at higher risk from long-term exposure to elevated radon levels. If you smoke and your home has high radon levels, you may face a lung cancer risk about 10 times greater than a nonsmoker, and much greater than your risk of developing lung cancer from smoking alone.

## C. Radon in Homes

Although radon's existence in air has been known for a long time, its natural presence in homes was not discovered until about 1984. Since then, high indoor radon levels have been found in almost every county in the United States.

Radon enters homes in several ways. It moves from soils into basements or lowest levels through openings such as cracks, loose fitting pipes, sump pits, dirt floors, slab joints, or block walls. Although less important in Nebraska, water supplies and building materials are two other potential sources.

## D. Testing for Radon

All Nebraska homes should be tested for radon, because only individual testing can determine which houses may have a radon problem. You cannot base your radon level on a neighbor's test result. Every house is different!

Measuring radon levels in your home is simple, inexpensive, and only takes a few minutes. Test kits can be purchased at most hardware and home supply stores that include complete instructions and return postage for mailing back to the analysis lab. Coupons for test kits are available from the Nebraska Department of Health and Human Services Radon Program office.

Short-term detectors (such as charcoal canisters) are used for two to seven days. They provide quick screening measurements indicating potential radon problems. Short-term detectors should be placed in the lowest livable level of the house, preferably during the winter.

Long-term detectors (such as alpha track detectors) are left in place for three months to one year. They provide the advantage of averaging seasonal variations associated with radon levels. Long-term detectors are generally placed in main living areas.

E. Interpreting Results

Radon measurements show how much radon was present in the home during the test period. This level can vary depending on detector location and the time of year it was used. Radon levels are generally highest when the house is closed and the measurements were taken in the basement or near possible radon entry routes. Readings averaging over an entire year are usually lower than those readings taken in a basement during winter months.

Radon gas is measured in units of picocuries per liter (pCi/L), a standard measure of radioactivity. The EPA has set 4 pCi/L as a "recommended action level." If a short-term measurement is over 4 pCi/L, the recommended action is to perform a follow-up test to better characterize the radon levels. If a long-term test is over 4 pCi/L, action should be taken to reduce radon exposures.

The following actions are recommended for the respective test results:
**Less than 4 pCi/L.** It is not necessary to take further action unless you desire.
**4 to 10 pCi/L.** Short-term results should be followed up with long-term measurements lasting approximately twelve months. Homes with long-term results in this range should take action to reduce exposures within the next few years.
**10 to 100 pCi/L.** Follow-up testing with another short-term test (no longer than three months) is recommended. Homes with results in this range should take action to reduce exposures within the next few months.
**Over 100 pCi/L.** Immediately notify the Department of Health and Human Services, Radon Program. Confirmatory short-term follow-up measurements should be performed as soon as possible, followed by mitigation (remediation).

In Nebraska, a random survey of over two thousand homes during the heating season of 1989-1990 found

more than half had radon screening tests above the EPA "action level." Although many Nebraska homes are "slightly high," few Nebraska readings have been in the "very high" category.

F. Reducing High Levels

Several methods have successfully reduced high levels in Nebraska homes and in other areas of the country. Although most reduction methods can be performed by the do-it-yourselfer, determining which method will work in your home can best be done by a professional trained in radon mitigation.

Sealing cracks and penetrations in the basement may reduce radon entry, but sealing every entry route may be very difficult and new cracks will continually develop. In most cases, sealing by itself is not a successful, permanent solution to elevated levels of radon.

The most effective method of reducing radon levels, and the method most often used in Nebraska homes, is changing the ventilation underneath the house by installing a fan driven system. These systems remove radon from below the foundation or crawlspace before it enters the home. The radon is drawn into pipes and exhausted into the atmosphere where it is diluted to safe levels.

Better ventilation of the home or continuous ventilation of the basement can reduce levels, especially in warmer months when windows can be left open. However, ventilation does not prevent radon entry and, if done incorrectly, can increase radon entry or cause damage to the home. Natural ventilation is not a permanent solution and may increase utility costs.

Providing exhaust appliances (such as furnaces, water heaters, and clothes dryers) with their own source of intake air can reduce the amount of radon drawn into the house.

## II. NEBRASKA INDOOR RADON SURVEY

A. Survey Design

Nebraska's indoor radon survey was a cooperative effort between the EPA and the former Nebraska Department of Health undertaken in the winter season of 1989-1990. To assess the indoor radon problem in Nebraska, the following survey design objectives were used:

1. Define any areas demonstrating potential for significant indoor radon gas concentrations. ("hot spots")
2. Assess the magnitude and extent of the radon public health threat within these "hot spots."
3. Characterize the distribution of radon gas concentrations in homes across the state and in regions of the state.
4. Assess the magnitude of the radon public health threat throughout Nebraska.

Single-family, owner-occupied detached homes with permanent foundations were randomly selected to

participate in the survey. At least one home in every county of Nebraska was tested for the survey. Survey results are statistically significant for regional areas only, not at the county level.

## B. Survey Results

Participating homes were tested using charcoal canister detectors in the basement or lowest livable level of the house for a period of two to seven days during the heating season. These screening measurements represent conservative estimates of maximum indoor radon concentrations and can be used to indicate potential problems. Screening measurements do not represent annual average concentrations, only the need for, and urgency of, follow-up measurements. Whenever possible, mitigation decisions should always be based on long-term measurements unless short-term measurements indicate the need for immediate action. Health risk estimates developed by the EPA are based on lifetime exposure to annual average radon levels.

| STATEWIDE RADON SURVEY SCREENING MEASUREMENT SUMMARY | | | | | |
|---|---|---|---|---|---|
| TOTAL NUMBER | AVERAGE (pCi/l) | PERCENT OVER 4 pCi/l | PERCENT OVER 20 pCi/l | HIGHEST (pCi/l) | LOWEST (pCi/l) |
| 2027 | 5.5 | 54% | 2% | 123.4 | < 0.5 |

## C. Summary and Conclusions

Nebraska's Indoor Radon Survey collected data in over 2,000 homes to assess the potential health threat of indoor radon in Nebraska homes with the following conclusions:

1. Approximately 54% of single family detached homes in Nebraska can expect to have indoor radon screening levels greater than the EPA recommended action level of 4 pCi/l. This represents the third highest percent of homes in the United States.

2. The statewide average screening level of 5.5 pCi/l represents the fourth highest average in the United States.

3. Only about 2% of the homes tested above 20 pCi/l, and only one home tested higher than 100 pCi/l. Although many homes have elevated levels, most are only slightly high and very few have levels of immediate concern.

4. Eastern Nebraska, especially the Northeastern counties, is where the highest indoor radon concentrations are found (See map on next page).

SCREENING SURVEY MAP GOES HERE

## III. ENVIRONMENTAL PROTECTION AGENCY MAP OF RADON ZONES

### A. Overview

The EPA, U.S. Geological Survey (USGS), and the Association of American State Geologists (AASG) worked together in 1993 to produce the EPA Map of Radon Zones. This map identifies, on a county-by-county basis, potential indoor radon levels for the United States.

The Map of Radon Zones was designed to assist national, state, and local governments and organizations in targeting their resources. It also intended to help building code officials determine areas of high priority for adopting radon-resistant building practices.

Zone designations for each county were determined by assessing five factors known to be important indicators of radon potential: indoor radon measurements, geology, aerial radioactivity, soil parameters, and predominant foundation construction techniques. Each county was assigned to one of three zones:

Zone 1 counties have a predicted average indoor screening level greater than 4 pCi/l.
Zone 2 counties have a predicted average indoor screening level between 2 and 4 pCi/l.
Zone 3 counties have a predicted average indoor screening level below 2 pCi/l.

### B. Study Results

Zone designations agreed very well with the results from the indoor radon testing survey performed by the Department of Health and the EPA. Nebraska had 53 of its 93 counties designated Zone 1 counties. Zone 2 counties numbered 24, and the remaining 16 counties were designated as Zone 3. Counties with the highest potential were located in Eastern and Southern Nebraska, and the Sand Hills area has, in general, low radon potential (see map on next page).

### C. Summary and Conclusions

The EPA, USGS, and AASG extensively studied five key factors affecting indoor radon with the following conclusions:

1. Potential indoor radon levels show a strong correlation with local geology.

2. Eastern and Southern Nebraska show high potential for elevated indoor radon concentrations.

3 Homes with elevated radon levels have been found in each of the three zone areas, and all homes should be tested regardless of zone designation.

RADON POTENTIAL MAP GOES HERE

NEBRASKA RADON SURVEY SCREENING MEASUREMENT RESULTS BY COUNTY
(results are statistically accurate only on a regional level, and may not be representative of the entire county)

| COUNTY | TOTAL # | AVERAGE | % OVER 4 | % OVER 20 | HIGHEST |
|---|---|---|---|---|---|
| Adams | 75 | 4.7 | 52 | 0 | 19.7 |
| Antelope | 20 | 4.8 | 40 | 0 | 12.6 |
| Arthur | 4 | 1.0 | 0 | 0 | 1.9 |
| Banner | 6 | 3.4 | 33 | 0 | 8.2 |
| Blaine | 5 | 1.5 | 20 | 0 | 5.5 |
| Boone | 17 | 6.1 | 59 | 0 | 14.8 |
| Box Butte | 37 | 2.8 | 19 | 0 | 9.3 |
| Boyd | 11 | 7.2 | 64 | 9 | 26.2 |
| Brown | 6 | 2.3 | 0 | 0 | 3.6 |
| Buffalo | 81 | 4.8 | 54 | 1 | 24.4 |
| Burt | 13 | 9.5 | 77 | 0 | 19.3 |
| Butler | 9 | 4.2 | 33 | 0 | 12.7 |
| Cass | 10 | 8.2 | 70 | 0 | 15.9 |
| Cedar | 32 | 9.0 | 72 | 9 | 24.5 |
| Chase | 15 | 4.2 | 60 | 0 | 9.1 |
| Cherry | 40 | 2.0 | 5 | 0 | 9.8 |
| Cheyenne | 45 | 3.5 | 24 | 0 | 12.7 |
| Clay | 14 | 7.0 | 57 | 0 | 20.0 |
| Colfax | 10 | 5.0 | 40 | 0 | 14.4 |
| Cuming | 26 | 6.3 | 58 | 4 | 24.6 |
| Custer | 40 | 3.6 | 28 | 0 | 11.5 |
| Dakota | 27 | 11.8 | 63 | 15 | 123.4 |
| Dawes | 34 | 4.3 | 38 | 0 | 13.9 |
| Dawson | 40 | 2.6 | 13 | 0 | 8.4 |
| Deuel | 5 | 3.1 | 20 | 0 | 6.3 |
| Dixon | 17 | 8.8 | 82 | 0 | 19.4 |
| Dodge | 16 | 5.4 | 50 | 0 | 16.2 |
| Douglas | 148 | 6.4 | 65 | 4 | 51.7 |
| Dundy | 7 | 2.6 | 29 | 0 | 4.8 |
| Fillmore | 6 | 7.7 | 67 | 17 | 20.1 |
| Franklin | 14 | 6.1 | 64 | 0 | 13.3 |
| Frontier | 8 | 2.9 | 25 | 0 | 4.9 |

NEBRASKA RADON SURVEY SCREENING MEASUREMENT RESULTS BY COUNTY
(results are statistically accurate only on a regional level, and may not be representative of the entire county)

| COUNTY | TOTAL # | AVERAGE | % OVER 4 | % OVER 20 | HIGHEST |
|---|---|---|---|---|---|
| Furnas | 12 | 4.5 | 58 | 0 | 8.8 |
| Gage | 10 | 6.0 | 70 | 0 | 12.3 |
| Garden | 28 | 3.0 | 21 | 0 | 16.9 |
| Garfield | 9 | 3.5 | 44 | 0 | 5.6 |
| Gosper | 4 | 4.9 | 50 | 0 | 8.2 |
| Grant | 2 | 0.6 | 0 | 0 | 1.0 |
| Greeley | 18 | 7.2 | 44 | 6 | 42.8 |
| Hall | 109 | 2.5 | 12 | 0 | 9.0 |
| Hamilton | 18 | 5.4 | 50 | 0 | 17.0 |
| Harlan | 8 | 5.2 | 63 | 0 | 9.4 |
| Hayes | 8 | 4.4 | 50 | 0 | 11.0 |
| Hitchcock | 10 | 4.2 | 60 | 0 | 9.6 |
| Holt | 34 | 2.4 | 18 | 0 | 8.4 |
| Hooker | 15 | 1.3 | 0 | 0 | 2.9 |
| Howard | 13 | 2.8 | 23 | 0 | 6.0 |
| Jefferson | 7 | 6.2 | 100 | 0 | 9.9 |
| Johnson | 1 | 21.0 | 100 | 100 | 21.0 |
| Kearney | 17 | 4.3 | 47 | 0 | 10.1 |
| Keith | 31 | 3.9 | 42 | 0 | 15.0 |
| Keya Paha | 6 | 1.3 | 0 | 0 | 3.1 |
| Kimball | 17 | 2.8 | 12 | 0 | 12.7 |
| Knox | 25 | 7.9 | 64 | 8 | 40.9 |
| Lancaster | 74 | 6.0 | 72 | 0 | 15.2 |
| Lincoln | 77 | 2.2 | 10 | 0 | 10.7 |
| Logan | 11 | 1.7 | 0 | 0 | 4.0 |
| Loup | 6 | 1.5 | 0 | 0 | 3.6 |
| Madison | 89 | 6.4 | 60 | 2 | 31.2 |
| McPherson | 4 | 1.7 | 0 | 0 | 3.8 |
| Merrick | 21 | 1.9 | 10 | 0 | 10.0 |
| Morrill | 26 | 2.2 | 15 | 0 | 7.7 |
| Nance | 16 | 5.4 | 63 | 0 | 13.7 |
| Nemaha | 7 | 7.8 | 86 | 0 | 16.2 |

NEBRASKA RADON SURVEY SCREENING MEASUREMENT RESULTS BY COUNTY
(results are statistically accurate only on a regional level, and may not be representative of the entire county)

| COUNTY | TOTAL # | AVERAGE | % OVER 4 | % OVER 20 | HIGHEST |
|---|---|---|---|---|---|
| Nuckolls | 19 | 7.6 | 79 | 0 | 15.2 |
| Otoe | 7 | 5.2 | 57 | 0 | 9.3 |
| Pawnee | 2 | 3.5 | 0 | 0 | 3.5 |
| Perkins | 9 | 3.3 | 44 | 0 | 8.5 |
| Phelps | 24 | 3.0 | 21 | 0 | 6.5 |
| Pierce | 14 | 7.4 | 57 | 7 | 22.9 |
| Platte | 11 | 3.3 | 18 | 0 | 9.1 |
| Polk | 6 | 6.2 | 83 | 0 | 13.2 |
| Red Willow | 25 | 4.2 | 44 | 0 | 13.0 |
| Richardson | 7 | 5.2 | 71 | 0 | 11.5 |
| Rock | 15 | 0.8 | 0 | 0 | 3.3 |
| Saline | 9 | 8.3 | 67 | 0 | 14.3 |
| Sarpy | 33 | 5.6 | 48 | 3 | 24.2 |
| Saunders | 8 | 6.9 | 63 | 0 | 10.9 |
| Scotts Bluff | 113 | 3.5 | 28 | 0 | 17.3 |
| Seward | 7 | 5.1 | 86 | 0 | 6.8 |
| Sheridan | 33 | 3.8 | 30 | 0 | 18.4 |
| Sherman | 8 | 4.0 | 63 | 0 | 6.3 |
| Sioux | 6 | 3.4 | 17 | 0 | 12.4 |
| Stanton | 11 | 4.9 | 36 | 0 | 13.8 |
| Thayer | 6 | 4.2 | 33 | 0 | 9.0 |
| Thomas | 10 | 1.5 | 10 | 0 | 5.0 |
| Thurston | 4 | 8.3 | 75 | 0 | 10.2 |
| Valley | 13 | 4.0 | 54 | 0 | 7.0 |
| Washington | 8 | 8.3 | 63 | 13 | 37.9 |
| Wayne | 18 | 9.3 | 72 | 6 | 20.2 |
| Webster | 12 | 4.0 | 42 | 0 | 9.0 |
| Wheeler | 6 | 1.4 | 0 | 0 | 3.0 |
| York | 12 | 5.8 | 67 | 0 | 15.9 |
| | TOTAL # | AVERAGE | % OVER 4 | % OVER 20 | HIGHEST |
| TOTALS | 2027 | 5.5 | 54 | 2 | 123.4 |

## REFERENCES

*A Citizen's Guide to Radon - The Guide to Protecting Yourself and Your Family from Radon*, U.S. EPA 402-K92-001, September 1992.

*Building a Radon Resistant House*, Nebraska Department of Health, 1996.

*Consumer's Guide to Radon Reduction - How to Reduce Radon Levels in Your Home...*, U.S. EPA 402-K92-003, August 1992.

*EPA's Map of Radon Zones - Nebraska*, U.S. EPA 402-R93-047, September 1993.

*The Geological Section of Nebraska*, Nebraska Geological Survey Bulletin 14A, 1959.

*Home Buyer's and Seller's Guide to Radon*, U.S. EPA 402-R93-003, March 1993.

*Protocols for Radon and Radon Decay Product Measurement in Homes*, U.S. EPA 402-R-93-003, June 1993.

*Radon Mitigation Standards*, U.S. EPA 402-R-93-078, October 1993.

*Technical Support Document for the 1992 Citizen's Guide to Radon*, U.S. EPA 400-R-92-011, May 1992.

## For More Information

The Nebraska Department of Health and Human Services Radon Program can provide you with a list of companies offering radon measurement or mitigation services in Nebraska. Pamphlets, brochures and other materials on radon are also available.

Questions or requests for information about radon can be directed to:

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